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FOSSIL ARTHROPODS OF CALIFORNIA. No. 21. TERMITES FROM CALICO MOUNTAINS NODULES.

Drawings by author. Photos by George Brauer.

INTRODUCTION

This is the first of a series of papers that will be presented on the Miocene Lake bed nodules from the Calico Mountains, San Bernardino County, California.

In 1954 I first read newspaper clippings about the finding of fossil insects in lacustrine deposits in the Mojave Desert. On August 6, 1954, Allison R. Palmer and Allen M. Bassett published a brief note on Nonmarine Arthropods from California, in Science, vol. 120, pp. 228, 229. In May 1955 I had the privilege of seeing some of these interesting fossil insects in Dr. Palmer's office in Washington, D.C. His official report on these nodules and the contained insects is in press.

Early in 1956 Mr. and Mrs. John H. Rouse called on me to show some fossil insects in nodules they had found in the Calico Mountains. They were unaware of the earlier findings of Palmer and Bassett. Since then they have made frequent trips to collect nodules. These have also been collected in the Calico Mountains by entomologists from the University of California at Riverside, and by Mr. and Mrs. Sam Kirkby, also of Riverside.

I have made two trips to the area in the company of Los Angeles County Museum personnel and others. The first was on May 10 and 11, 1956, with George P. Kanakoff, Curator of Invertebrate Paleontology at the Museum, accompanied by Rostick Ryshkoff, Dara Shilo, Jeanne Hotchkiss, Mr. and Mrs. John G. Carr, and Mr. and Mrs. Rouse. On that trip we acquired for the Museum 4153 nodules from several sites in different canyons.

On April 12-14, 1957, our second party of 14 persons consisted of myself, George P. Kanakoff, and Rudolph Pesci of the Museum; Dr. Richard E. Loomis and Delmer Mangum of Long Beach State College; Mr. and Mrs. John G. Carr, Mr. and Mrs. Charles Artman, and Ralph Ackerman, and four students, Wilma Webster, Judy Clark, Sheryl Weber, and Elza Kops.

As a result of these trips and supplementary specimens received from Mrs. Rouse and Mrs. Kirkby, the Museum collection has reached a total of 10,266 specimens. These were collected at 38 sites in 109 separate lots, in 9 different quarter sections of the Yermo Quadrangle. Details of our findings will be published after the release of Dr. Palmer's report. Inasmuch as he is not reporting on termites, I am free to report on these at this time.

Only five Miocene termite species have been previously reported from the United States, and these are listed in the new list at the end of this article.

DESCRIPTIONS OF FOSSIL–BEARING NODULES

It is my pleasure to report the finding of ten nodules with termite wing impressions, all in Switchback Canyon in NE ¼ and NW ¼ of Section 19, Yermo Quadrangle, but at 5 different sites in the canyon, all at altitudes of 2700 to 3000 feet. The nodules are of entirely different types and formation, so that we can assume at least four different conditions of deposit.

The LACMIP sites are registered as Los Angeles County Museum Invertebrate Paleontology sites.

Site 10 (LACMIP 357) in NE ¼ Sect. 19, which we called the Rouse anticline, is located at the Switchback, upper level, altitude about 2700 feet. Here a great number of annual strata lie in a sharp anticline fold. Inasmuch as the annual varves are between 20 and 25 to the inch, and the deposit is over 10 feet thick, there is at least a 2400-year deposit of nodules. Nodule No. 1365, a yellow disc, containing Specimen 505, was found by Rostick Ryshkoff, May 10, 1956. It weighs 40.5 grams, and measures 48 x 34 x 19.5 mm., broken on one side, so that original size was probably 48 x 41 x 19.5 mm. It was formed of 7 or 8 layers and may

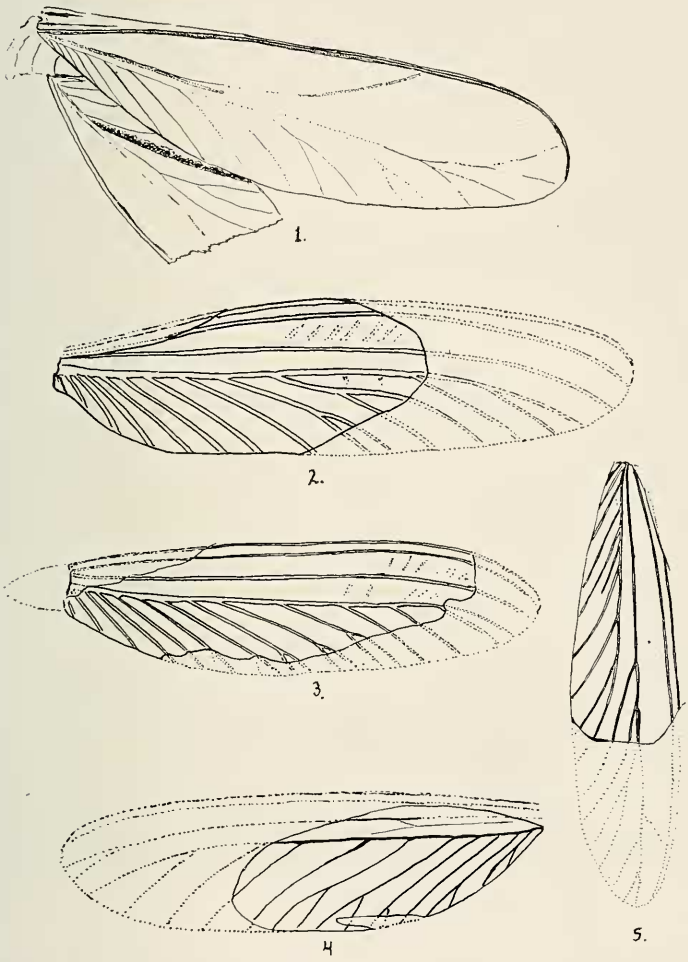

PLATE 5

1. Wing Pattern, *Cryptotermes ryshkoffi* n. sp., Specimen 505.
2. Wing Pattern, *Parastylotermes calico* n. sp., Specimen 553.
3. Wing pattern, *Reticulitermes laurae* n. sp. Specimen 912.
4. Wing pattern, *R. tibialis dubitans* n. sp., Specimen 376.
5. Wing pattern, *Gnathamitermes magnoculus rousei* n. sp., Specimen 362.

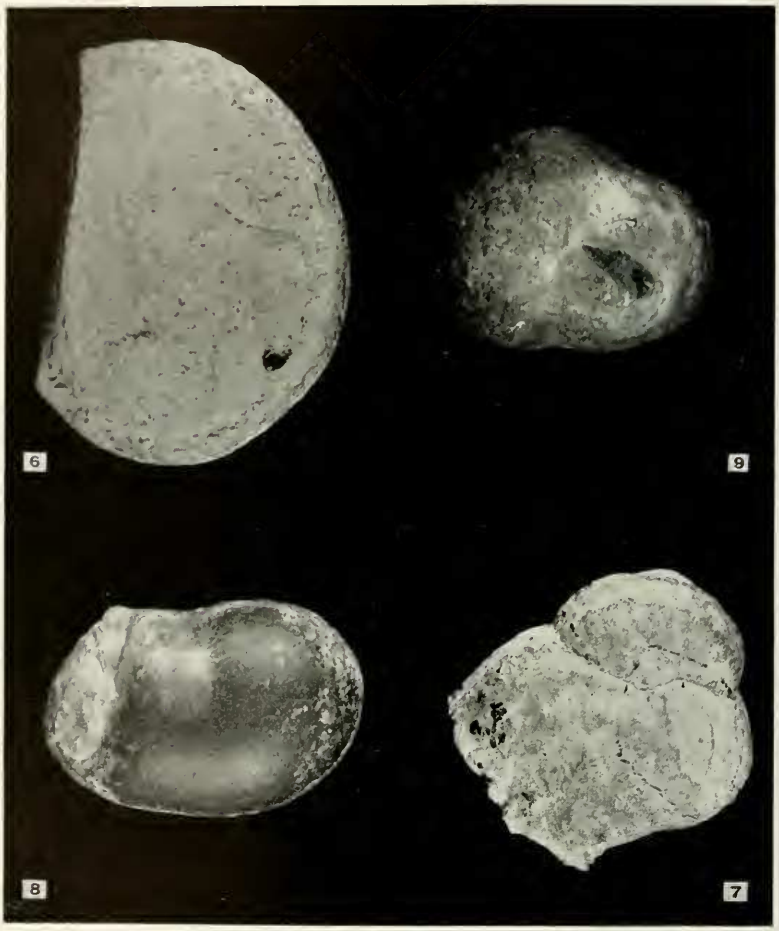

PLATE 6

6. Nodule 1365 showing specimen 505, *Cryptotermes ryshkoffi* n. sp.
7. Nodule 5485 showing specimen 553, *Parastylotermes calico* n. sp.
8. Nodule 4142 showing specimen 494, *Reticulitermes laurae* n. sp.
9. Nodule 4067 showing specimen 362, *Gnathamitermes magnoculus rousei* n. sp.

have been a rolling disc which settled in a water depression, and on which as the last coat was being added, in the final matrix, a termite body was included in the upper layer. (Figure 6).

Site 25 (LACMIP 373), also in NE ¼ Sect. 19, is an upward extension of the Rouse anticline, altitude 2725 feet. John Carr found (April 12, 1957) in the matrix, a small mottled gray and white mammillate nodule, No. 4802, with upper portion concave. On the under side is Specimen 547, part of which has been eroded. The complete nodule weighs 3.1 grams, and measures 20 x 19 x 9.5 mm.

Site 24 (LACMIP 372), just over in NW ¼ Sect. 19, is a large dump of white rock in the canyon bed, a very short distance up from the switchback, altitude about 2700 feet. Nodule 5485, found by Wilma Webster, April 12, 1957, is a broken specimen of a bimammillate nodule. It is quite complex in structure, with at least 5 years growth, and the Specimen 553 is inset on the upper surface. The fragment weighs 9.65 grams, and measures 24 x 22 x 19 mm. (Figure 7).

Site 16 (LACMIP 363), farther up the canyon, in NW ¼ Sect. 19, is a borax mine dump, altitude about 2900 feet. Here Mrs. Rouse has found nodules 4066, 4067, 10265, and 10266.

Nodule 4066 is gray blue, layered, mound shape, bearing on its side Specimen 376. The nodule weighs 10.05 grams, and measures 26 x 23.5 x 15 mm.

Nodule 4067 is blue black, bearing on its upper side Specimen 362. The nodule weighs 6.9 grams, and measures 21.5 x 19 x 13 mm. (Figure 9).

Nodule 10265 is gray blue, of very complex nature. It has had several stages of growth, the first stages almost vertical to the last. In the vertical there are at least 8 annual growth layers, and in the last part about 6 annual growth layers. The Specimen 912 lies on the under side of this latest growth (Figure 10). The nodule weighs 49.4 grams, and measures 48.5 x 46.5 x 22.5 mm. On the upper side of the nodule there is also a petrified larva.

Nodule 10266 is also gray blue, mammillated, weighs 12.8 grams, and measures 30 x 22 x 18 mm. The Specimen 913 lies on the side of the nipple beneath. The growth lines are obscure.

At site 16B (LACMIP 364) nearby, Mrs. Rouse found a matrix deposit of horizontal strata, in which were imbedded nodules 4138, 4142, and 10264.

Nodule 4138 is many layered, yellow gray in color, and of inverted bee hive shape, weight 29 grams, measuring 33 x 30 x 27 mm. Specimen 496 was just under the outer ledge.

Nodule 4142 is blue black, shaped like a large bean, weighing 7.4 grams, measuring 25 x 16.5 x 13 mm. Specimen 494 is on a ledge near the end. (Figure 8)

PLATE 7

10. Enlargement of wing of *Reticulitermes laurae*, n. sp., specimen 912.

Nodule 10264 is a gray, layered, round nodule, weighing 11 grams, measuring 24 x 21.5 x 16.5 mm., and giving evidence of about 8 years growth. Specimen 862 is on the upper surface with edges worn to conform to the nodule shape.

All of these nodules apparently originated elsewhere than the matrix in which finally deposited, and it was in the final resting

place that the termite wings fell into the water, and were incorporated on the completing nodule. In each case there is a little ledge built up to the wing impression. Except in Specimen 505 the fossil is a cast of the wing, but 505 is of different color and probably a petrification of the part of the body and the wings.

DESCRIPTIONS OF SPECIES

I determine the wings as belonging to five species in four genera.

Kalotermitidae. Kalotermitinae.
Genus Cryptotermes Banks.

Cryptotermes ryshkoffi, new species (Figures 1, 6).

Named in honor of Rostick Ryshkoff, who found nodule 1365 on which the specimen occurs, May 11, 1956.

Holotype: Specimen 505 (L.A. County Museum Invertebrate Paleontology Type No. S 9097), a right anterior wing, and a left posterior wing, with three dorsal segments, lying on the upper surface of a disc-shaped nodule. The specimen seems to be actually a petrification of the wings and thorax, as the color is distinct from that of the yellow nodule. When found the costal base was concealed, but by careful needle work it was exposed, clearly revealing characteristics of the genus *Cryptotermes.*

Description: Actual length of anterior wing 10.5 mm., hind wing 9.6 mm. Except at base, venation very faint. Basal costal triangle not well defined. Radius$_4$+$_5$ a strong vein from base to apex. Media parallel and close to Cubitus in basal third, sending a curving branch to join Radius $_4$+$_5$ at apical third (characteristic of the genus). Cubitus well defined in basal third, faintly beyond. First seven cubital branches clearly defined and unforked. Beyond these the veins are faintly outlined, but I count thirteen branches in all, of which the 10th, 11th, and 12th are forked. Beyond the 12th, Cubitus turns upward to meet Radius $_4$+$_5$ at apex. Hind wing complete, but so finely lined that only a few cubital branches are clear.

Only two living species of this tropical genus occur in the United States, neither of them west of Louisiana. The fossil species has a longer wing than either of them, and the venation is distinct.

Rhinotermitidae. Styloterminitinae.
Genus Parastylotermes Snyder.

Parastylotermes calico, new species (Figures 2, 7)

Holotype: Specimen 553 (L.A. Mus. Inv. Paleon. Type No. S 9094) from Nodule 5484, collected by Wilma Webster, April, 1957. An incomplete wing impression.

Description: The specimen is placed in Genus *Parastylotermes* because Media is closer to Cubitus than to Radius $_4+_5$, and because there are apparently only two basal veins, SC-R and R_1+_2.

Wing impression measures 7.8 mm., and with typical proportional extension should have measured 12.14 as an entire wing. Cubitus shows 11 branches, and I assume one more to fit the pattern. Of these branches, only the 9th and 10th are forked. As in *P. washingtonensis* Snyder of the Miocene of Washington, several cross veinlets occur between Media and Radius $_4+_5$. Distinguished from *P. washingtonensis* which measures 11.5 mm., by different Cubital pattern, that species having 13 primary branches, with 3rd, 5th, and 8th forked.

Rhinotermitidae. Heterotermitinae. Genus Reticulitermes Holmgren.

Reticulitermes laurae, new species (Figures 3, 8, 10)

Holotype: Specimen 912 (L.A. Mus. Inv. Paleon. Type No. S 9095) impression of wing on nodule 10265, collected by Mrs. Laura Rouse in 1957.

Paratypes: Specimen 494 on nodule 4142; Specimen 913 on nodule 10266; Specimen 496 on nodule 4138; and Specimen 862 on nodule 10364, collected and retained by Mrs. Rouse. Though fragmentary all specimens fit to one wing pattern, with same dimensions.

Description: In order to determine the entire wing length, the wing pattern of *Reticulitermes tibialis* Banks, which now occurs throughout the Western United States, was superimposed on scale drawings of the five fossil specimens. In this manner it was possible to extend the veins and obtain an hypothetical picture of the entire wing. The pattern is clearly that of *Reticulitermes*.

The wing pattern in accordance with the terminology of J. H. Comstock is as follows: Costa-Subcosta-Radius a single marginal vein extending entire length of wing. Radius $_4+_5$ runs parallel to the margin and extends to the apex. Media is a straight vein from base to apex, lying half way between Radius $_4+_5$ and Cubitus. Cubitus runs parallel to Media, finally curving down to posterior margin near the apex. It occupies slightly more than half the width of the wing, and has 13 branches to the margin, of which the 6th to 10th have short branches. There is more or less indication of transverse reticulation, or cross veins above and below Media.

The largest fragment (holotype) measures 8.9 mm., thus greatly exceeding the entire length of the wings of the three known species of this genus in Southern California. Extending to its full size the deciduous part of the wing should have measured 10.3 mm. The wings of the now existing species measure

as follows: *R. tibialis* Banks 8.4 mm.; *R. flavipes* Kollar fore wing 8.0 mm., hind wing 7.0 mm., *R. hesperus* fore wing 7.2 mm., hind wing 6.9 mm. The Miocene fossil *R. creedei* Snyder fore wing measures 6.5 mm. The Miocene fossil *R. fossarum* (Scudder) had fore wings measuring 7.75 to 9.25 mm.

Aside from size this species is outstanding for the clarity of the venation, all veins being clearly outlined in the fossil casts. The living *R. tibialis, R. hesperus,* and *R. flavipes* have Subcosta and Radius$_4$+$_5$, and the basal parts of Media and Cubitus clear, the outer portions very faint. The fossil *R. fossarum* has only the two basal veins clear, all other venation obscure. The fossil *R. creedei* has all venation well defined, but different in character from this species.

Reticulitermes tibialis dubitans, new subspecies (Fig. 4)

Holotype: Specimen 376 on Nodule 4066, collected by Mrs. Laura Rouse, and retained by her.

Description: The wing impression consists of the Cubital area with 1st, 2nd, 4th, 5th, and 6th branches forked, and a short stretch of Media. It is a badly crumbled specimen in the outer portion. The impression measures 6.7 mm., and on the basis of probable extension in the proportions of *R. tibialis,* the length of this wing would be 10.6 mm.

I am placing this large fossil wing in *R. tibialis* because the portion available has the same characteristics of cubital branching found in the living species. In the Banks figure of *R. tibialis* fore wing, the first Cubital is bent as if it had a branch, and the 2nd, 4th and 5th are branched. In the hind wing only the 3rd is indicated as branched. The total number of Cubital branches in *tibialis* is 10, as would seem to be the case in the present specimen. Actual wings of *R. tibialis* studied measured only 8.4 mm. in length.

Although found in the same general locality as the specimens of *R. laurae,* this specimen apparently represents a different species.

Reticulitermes sp.

Specimen 547 on Nodule 4802 is too small for specific definition. It consists of a part of the cubital system with five parallel veins, the first of which is forked near its base. A similar character occurs in *R. creedei* Snyder, but, according to pattern, in a different position.

Termitidae. Amitermitinae.

Gnathamitermes magnoculus rousei, new subspecies (Figs. 5, 9).

Holotype: Specimen 362 (L.A. Mus. Inv. Paleon. Type No. S 9096), on nodule 4067, collected by Mrs. Laura Rouse.

Gnathamitermes magnoculus Light 1932, from Calexico, California has been synonymized by Snyder with *G. perplexus* Banks 1920 of Victoria, Texas, but the venation of the wings of the two species is entirely different, and I am inclined to restore it to specific rank. Its forewing measures about 8.40 mm.

The fossil print fits the pattern of *G. magnoculus* by having the first forking of Media opposite the branching of the 8th or last Cubital; whereas *G. perplexus* has the Medial branch far beyond the last Cubital branch.

Description: The length of the fossil specimen is 6.5 mm., and an extension in the pattern of *G. magnoculus* would give a probable total length of 8.8 mm. The basal Costa-Subcosta-Radius and the $Radius_1+_5$ run parallel to the apex. Media is closer to Cubitus than to $Radius_4+_5$, and two branches are evident. Beyond this we assume that there were probably three branches. The first Medial branch is directly opposite the last Cubital branch. Cubitus terminates at distal third of wing and has 8 complete branches as in *magnoculus;* differs from the living form in that between the 5th and 6th there is apparently an abortive branch. There are faint lines between Media and $Radius_1+_5$.

The wing in this genus differs from that of *Reticulitermes* by having the Media branched; and by having Cubitus terminate at a distance before the apex.

The presence of a tube-forming termite in this area suggests, according to Light (1932. Contribution toward a Revision of the American species of Amitermes Silvestri, Univ. Calif. Publ. in Entom. 5(17):355-414, plates 9, 10, 10 figs.), that moisture and temperature were practically constant at a depth of 48 inches, with the air saturated and maximum temperature of 76°F., when maximum temperature is up to 101°F. In May the tubes of the living termites have a saturated moisture content in early morning when the termites are in the tubes. As the moisture content decreases during the day the termites retreat into the ground. They build earthen tubes around plants, and feed on the outer tissues. This species swarms in August and September after heavy showers.

Of the four genera represented on the Miocene nodules, *Reticulitermes* and *Gnathamitermes* are still present in the desert areas of California; *Cryptotermes* does not now occur west of Louisiana; and is generally tropical; *Parastylotermes* is only known from the Miocene.

LIST OF NORTH AMERICAN FOSSIL TERMITES.

Kalotermitidae. Electrotermitinae.

1. *Prokalotermes hageni* (Scudder) *(Paratermes h.* Scudder)
   1890. Tertiary Insects of N. Amer., U.S. Geol. Surv. Terr., vol. 13, p. 110, pl. 12. fig. 2; alate; Miocene; Florissant, Colorado.

Kalotermitidae. Kalotermitinae.

2. *Kalotermes* sp.
   1946. Lance. Bull. So. Cal. Acad. Sci., vol. 45 (1):21-27; pellets; Pleistocene asphalt; Carpinteria, California.
3. *Cryptotermes ryshkoffi* Pierce
   1958. This article; wing impression; Miocene; Calico Mts., Calif.

Hodotermitidae. Termopsinae.

4. *Zootermopsis* (?) *coloradensis* (Scudder) *(Hodotermes c.* Scudder)
   1883. Proc. Amer. Ac. Arts & Sci., vol 19 (n.s. Vol. 2), pt. 1, p. 142.
   1890. Tert. Ins. l. c. 113, pl. 12, fig. 6; alate; Upper Miocene; Florissant, Colorado.
5. *Zootermopsis* sp.
   1946. Lance. l. c; pellets; Pleistocene asphalt; Carpinteria, California.

Rhinotermitidae. Stylotermitinae.

6. *Parastylotermes washingtonensis* (Snyder 1931) *(Stylotermes w.* Snyder)
   1931. Ann. Ent. Soc. Amer. vol. 24(2):317, pl. 1, fig. 5; wing; Miocene Latah formation; near Spokane, Washington.
7. *Parastylotermes calico* Pierce
   1958. This article; wing impression; Miocene nodule; Calico Mts., California.

Rhinotermitidae. Heterotermitinae.

8. *Reticulitermes fossarum* (Scudder) *(Eutermes f.* Scudder)
   1883. l. c. p. 143.
   1890. l. c. p. 115, pl. 12, fig. 20.
   (Eutermes meadi Scudder 1883. l. c., p. 144; 1890, l. c. pl. 12, fig. 12, 17); alates; Upper Miocene; Florissant, Colorado.

9. *Reticulitermes creedei* Snyder.
   1938. Psyche, vol. 45 (¾):109-110, pl. 13, fig. 3; wing; Miocene; Creede, Colorado.
10. *Reticulitermes laurae* Pierce.
   1958. This article; wing impression; Miocene nodule; Calico Mts., California.
11. *Reticulitermes tibialis dubitans* Pierce
   1958. This article; wing impression; Miocene nodule; Calico Mts., California.

Termitidae. Amitermitinae.

12. *Gnathamitermes magnoculus rousei* Pierce.
   1958. This article; wing impression; Miocene nodule; Calico Mts., California.

Mastotermitidae

13. *Blattotermes wheeleri* (Collins 1925) Riek 1952 (Mastotermes), Eocene of Tennessee.
   Collins, R. L., 1925. Amer. Journ. Sci. 9(5):406-410.
   Riek, E. F., 1952. Univ. Queensland Papers, Dept. Geol. 4 n.s. (2): 18, 19, fig. 2.

ORBICULAR GABBRO NEAR PINE VALLEY, CALIFORNIA

By Richard Merriam

ABSTRACT. An orbicular phase of the San Marcos gabbro occurs near the contact with Triassic (?) schist. Orbicules average several inches in diameter, have distinct radial structure and numerous concentric zones. Most orbicules have gabbroic cores, others lack nuclei and some surround schist fragments. Orbicule formation appears to be aided by (1) abundant mineralizers, (2) fluctuations of magma temperature and (3) presence of xenoliths.

INTRODUCTION

Two closely spaced exposures of orbicular gabbro lie in the southwestern corner of the Cuyapaipe quadrangle near the Sheephead truck trail approximately four miles southeast of Pine Valley, San Diego County, California. Plate 8 gives the location and Plate 9 the geologic relationships.